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STATUTORY DECLARATION

I, Kyung Gu KANG, a citizen of the Republic of Korea and a staff member of Y.H.KIM INTERNATIONAL PATENT & LAW OFFICE specializing in "X-RAY DETECTING DEVICE AND FABRICATING METHOD THEREOF" do hereby declare that:

I am conversant with the English and Korean languages and a competent translator thereof.

To the best of my knowledge and belief, the following is a true and correct translation of the Relativity Document (No. P2000-85281) in the Korean language already filed with Korean Industrial Property Office on December 29, 2000.

Signed this 3th day of July, 2006

Kyung Gu KANG

PATENT APPLICATION

DOCUMENT NAME: PATENT APPLICATION

TO: COMMISSIONER

DATE: December 29, 2000

TITLE OF THE INVENTION: X-RAY DETECTING DEVICE AND FABRICATING METHOD THEREOF

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The present application is filed pursuant to Article 42 of the Korea Patent Act.

Patent Attorney

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[ABSTRACTS]

[ABSTRACT]

The present invention relates to an X-ray detecting device and a fabricating method thereof.

A method of fabricating an X-ray detecting thin film transistor substrate includes the steps of forming a thin film transistor having a gate electrode, a drain electrode and a source electrode on a substrate, entirely forming a first protective film for covering the thin film transistor, forming a first contact hole for exposing the drain electrode of the thin film transistor on the first protective film, entirely forming a second contact hole for covering the first protective film on the first protective film, forming a second contact hole provided on the second protective film centering around the first contact hole for exposing the drain electrode of the thin film transistor, and forming a transparent electrode for connecting to the drain electrode of the thin film transistor by way of the second contact hole on the second protective film.

In the method, the second contact hole has a larger width than the first contact hole to prevent an under-cut phenomenon, so that it becomes possible to obtain stable step coverage.

[REPRESENTATIVE DRAWING]

Fig. 3

[SPECIFICATION]

[TITLE OF THE INVENTION]

X-RAY DETECTING DEVICE AND FABRICATING METHOD THEREOF

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a diagram showing a panel of a related art X-ray detecting device;

Fig. 2A to Fig. 2E are sectional views showing the method of fabricating the X-ray detecting device shown in Fig. 1 step by step;

Fig. 3 is a sectional view showing a structure of an X-ray detecting device according to an embodiment of the present invention; and

Fig. 4A to Fig. 4E are sectional views showing the method of fabricating the X-ray detecting device shown in Fig. 3 step by step;

<DETAILED DESCRIPTION OF THE REFERENCE NUMERALS>

2, 52: glass substrate

3, 53: gate line

4: thin film transistor substrate

5, 55: pixel electrode

6: photo sensitive layer

7: upper dielectric layer

8: upper electrode

9: high voltage generator

10, 60: data line

12, 62: gate electrode

14, 64: source electrode

15, 17, 65, 67: contact hole

16, 66: drain electrode

22, 72: storage electrode

25, 75: transparent electrode

32, 82: gate insulating film

34, 84: active layer

36, 86: SiNx

38, 40, 88, 90: protective film

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[TECHNICAL FIELD INCLUDING THE INVENTION AND PRIOR ART THEREIN]

This invention relates to a method of fabricating an X-ray detecting device, and more particularly to a method of fabricating an X-ray detecting device that is adaptive for obtaining stable step coverage.

A diagnostic X-ray detecting system for photographing an image by irradiating not visible rays but an X-ray has been extensively used for medical applications. An X-ray detecting system requires a detecting device for detecting an X-ray.

Generally, an X-ray imaging system photographing an object using a non-visible light ray such as an X-ray, etc. has been used for medical, science and industry applications. This X-ray imaging system includes an X-ray detecting panel

for detecting an X-ray passing through an object to convert it into an electrical signal.

Fig. 1 is a plan view showing a panel of a related art X-ray detecting device.

Referring to Fig. 1, An AMLCD includes a photo sensitive layer 6 in which an X-ray is incident, and a thin film transistor (hereinafter, referred to as "TFT") formed on a glass substrate 2 to switch an X-ray detected from the photo sensitive layer 6. The photo sensitive layer 6 made from a selenium with a thickness of hundreds of μm is coated on the TFT array 4 to play a role to convert the X-ray into an electrical signal. A dielectric layer 7 and an upper electrode 8 are formed on the photo sensitive layer 6. The upper electrode 8 is connected to a high voltage generator 9. The TFT array 4 transmits a voltage signal charged into a storage capacitor Cst in response to a control signal inputted by way of the gate line 3 to a data reproducer (not shown). The storage capacitor Cst is connected between the source electrode of the TFT and a ground voltage source GND to play a role to charge a signal supplied from the photo sensitive layer 6.

The TFT supplies a voltage charged into a charge capacitor Cst in response to a gate signal inputted via the gate line 3 to the data line 10. Pixel signals supplied to

the data line is applied, via the data reproducer, to a display device, thereby displaying a picture.

Fig. 2A to Fig. 2E are sectional views showing the method of fabricating the X-ray detecting device shown in Fig. 1 step by step, which emphasizes a thin film transistor portion and a storage capacitor portion.

Referring to Fig. 2A, a metal layer is formed on the glass substrate 2 by using a deposition technique. Then, the metal layer is patterned by a mask pattern to provide a gate electrode 12. In this case, the gate electrode 12 has a structure in which an aluminum Al and a molybdenum Mo are sequentially disposed.

Referring to Fig. 2B, a gate insulating film 32, an amorphous silicon layer (a-Si) and an amorphous silicon layer (n+) doped with an impurity are sequentially formed on a front side of the glass substrate 2 provided with the gate electrode 12 by using a consecutive deposition technique. In this case, the gate insulating film 32 having an approximately 4000Å thickness is formed by using a SiNx. Next, the amorphous silicon layer (a-Si) and the amorphous silicon layer (n+) doped with an impurity are patterned by the mask pattern to provide an active layer 34 forming a channel of the TFT. After forming a Chrome Cr, then the Cr is patterned by the mask pattern to provide a source electrode 14, a drain

electrode 16 and a storage electrode 22.

Referring to Fig. 2C, a first protective film 38, that is, a SiNx is entirely coated on the glass substrate provided with the source electrode 14, the drain electrode 16 and the storage electrode 22. Next, an organic insulating film having a low dielectric constant, that is, a second protective film 40 is formed in order to reduce a parasitic capacitance.

Referring to Fig. 2D, after forming the first and second protective films 38 and 40, then the first and second protective films 38 and 40 are patterned by using the mask pattern to provide a first contact hole 15 for contacting the drain electrode 16 with a transparent electrode 25 to be formed later at an area of a pixel portion and the TFT, and a second contact hole 17 for contacting the storage electrode 22 with the transparent electrode 25. Herein, the first and second contact holes 15 and 17 are formed by way of the first and second protective film 38 and 40.

Referring to Fig. 2E, after forming the first and second protective films 38 and 40, then a transparent electrode material is entirely coated. Next, the coated first and second protective film 38 and 40 are patterned by using the mask pattern to provide the transparent electrode 25. The transparent electrodes 25 is connected to each other by the first and second contact holes 15 and 17 formed on the drain

electrode 16 and the storage electrode 22. Next, a SiNx 36 is disposed on the first and second protective films 38 and 40 provided with the transparent electrode 25, and then the transparent electrode material is entirely coated onto it. Next, the coated first and second protective films 38 and 40 are patterned by using the mask pattern to provide the pixel electrode 5.

After forming the pixel electrode 5, a molybdenum Mo layer exposed via contact holes of a gate pad and a data pad is patterned by using the mask pattern to be exposed an aluminum Al layer. This is for forming an aluminum structure in order to connect the gate pad and the data pad to a driving IC chip by an aluminum Ad wire bonding having a high adhesion strong.

But, in a related art method of fabricating an X-ray detecting device, when the first and second protective film formed at an area of the storage capacitor and the TFT are sequentially etched by using one dry-etching process, the first protective film, that is, an etching ratio of the SiNx is faster than that of the second protective film, that is, an organic insulating film. Thus, the SiNx is etched under the second protective film, that is, the organic insulating film to generate an under-cut phenomenon. Step coverage of the transparent electrode disposed on an upper protective film is

deteriorated by the under-cut phenomenon, so that it becomes possible to generate a single line defect at a stepped portion.

[TECHNICAL SUBJECT MATTER TO BE SOLVED BY THE INVENTION]

Accordingly, it is an object of the present invention to provide a method of fabricating an X-ray detecting device that is adaptive for preventing a defect by an over-etching of a SiNx upon forming of a contact hole via a protective film, that is, a SiNx layer and an organic insulating film.

[CONFIGURATION AND OPERATION OF THE INVENTION]

In order to achieve these and other objects of the invention, in a method of fabricating an X-ray detecting thin film transistor substrate according to the present invention, the present invention includes the steps of forming a thin film transistor having a gate electrode, a drain electrode and a source electrode on a substrate, entirely forming a first protective film for covering the thin film transistor, forming a first contact hole for exposing the drain electrode of the thin film transistor on the first protective film, entirely forming a second contact hole for covering the first protective film on the first protective film, forming a second contact hole provided on the second protective film centering around the first contact hole for exposing the drain electrode

of the thin film transistor, and forming a transparent electrode for connecting to the drain electrode of the thin film transistor by way of the second contact hole on the second protective film.

In the method, a width of the second contact hole is thinner than that of the first contact hole.

In order to achieve these and other objects of the invention, in a method of fabricating an X-ray detecting storage capacitor according to the present invention, the present invention includes the steps of forming a storage capacitor having a storage electrode on a substrate, entirely forming a first protective film for covering the storage electrode, forming a first contact hole for exposing the storage electrode of the storage capacitor on the first protective film, entirely forming a second contact hole for covering the first protective film on the first protective film, forming a second contact hole provided on the second protective film centering around the first contact hole for exposing the storage electrode of the storage capacitor, and forming a transparent electrode for connecting to the storage electrode of the storage capacitor by way of the second contact hole on the second protective film.

In the method, a width of the second contact hole is thinner than that of the first contact hole.

These and other objects of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

Hereinafter, the preferred embodiments of the present invention will be described in detail with reference to Fig. 3 and Fig. 4E.

Fig. 3 is a sectional view showing a structure of an X-ray detecting device according to an embodiment of the present invention, and more particularly to a sectional view only showing a TFT and a storage capacitor area.

Referring to Fig. 3, an X-ray detecting device of the present invention in comparison with a related art X-ray detecting device etches a first protective film to provide a first contact hole, and then disposes and etches a second protective film to provide a second contact hole. Accordingly, a width of the second contact hole should be thinner than that of the first contact hole.

Fig. 4A to Fig. 4E are sectional views showing the method of fabricating the X-ray detecting device shown in Fig. 3 step by step, and more particularly to a sectional view only showing a thin film transistor portion and a storage capacitor portion.

Referring to Fig. 4A, a metal layer is formed on a glass

substrate 52 by using a deposition technique. Then, the metal layer is patterned by a mask pattern to provide a gate electrode 62. In this case, the gate electrode 68 has a structure in which an aluminum Al and a molybdenum Mo are sequentially disposed.

Referring to Fig. 4B, a gate insulating film 82, an amorphous silicon layer (a-Si) and an amorphous silicon layer (n+) doped with an impurity are sequentially formed on a front side of the glass substrate 5 provided with the gate electrode 62 by using a consecutive deposition technique. In this case, the gate insulating film 82 having an approximately 4000Å thickness is formed by using a SiNx. Next, the amorphous silicon layer (a-Si) and the amorphous silicon layer (n+) doped with an impurity are patterned by the mask pattern to provide a semiconductor layer 84 forming a channel of the TFT. After forming a Chrome Cr, then the Chrome Cr is patterned by the mask pattern to provide a source electrode 64, a drain electrode 66 and a storage electrode 72.

Referring to Fig. 4C, a first protective film 88, that is, a SiNx is entirely coated on the glass substrate provided with the source electrode 64, the drain electrode 66 and the storage electrode 72, and patterned by using the mask pattern to provide a first contact hole 65 for contacting the drain electrode with a transparent electrode to be formed later at

an area of a pixel portion and the TFT, and for contacting a storage electrode with a transparent electrode.

Referring to Fig. 4D, after forming the first contact hole 65, then an organic insulating film having a low dielectric constant, that is, a second protective film 90 is entirely coated onto it in order to reduce a parasitic capacitance, and patterned by using the mask pattern to provide the second contact hole 67 having a thinner width than that of the first contact hole 65.

Referring to Fig. 4E, after forming the first and second protective films 88 and 90, then a transparent electrode material is entirely coated. Next, the coated first and second protective film 88 and 90 are patterned by using the mask pattern to provide the transparent electrode 75. The transparent electrodes 75 is connected to each other by the first and second contact holes 65 and 67 formed on the drain electrode 66 and the storage electrode 72. Next, a SiNx 86 is disposed on the first and second protective films 88 and 90 provided with the transparent electrode 75, and then the transparent electrode material is entirely coated onto it. Next, the coated first and second protective films 88 and 90 are patterned by using the mask pattern to provide the pixel electrode 55.

After forming the pixel electrode 55, a molybdenum Mo

layer exposed via contact holes of a gate pad and a data pad is patterned by using the mask pattern to be exposed an aluminum Al layer. This is for forming an aluminum structure in order to connect the gate pad and the data pad to a driving IC chip by an aluminum Ad wire bonding having a high adhesion strong.

[EFFECT OF THE INVENTION]

As described above, a method of fabricating an X-ray detecting device according to the present invention disposes and etches a first protective film, and disposes and etches a second protective film to prevent an under-cut phenomenon. Thus, stable step coverage can be obtained, so that it becomes possible to prevent a single line defect at a stepped portion.

Although the present invention has been explained by the embodiments shown in the drawings described above, it should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined only by the appended claims and their equivalents.

What is claimed is:

1. A method of fabricating an X-ray detecting thin film transistor, in a method of fabricating an X-ray detecting thin film transistor substrate, comprising the steps of:

forming a thin film transistor having a gate electrode, a drain electrode and a source electrode on a substrate,

entirely forming a first protective film for covering the thin film transistor,

forming a first contact hole for exposing the drain electrode of the thin film transistor on the first protective film,

entirely forming a second contact hole for covering the first protective film on the first protective film,

forming a second contact hole provided on the second protective film centering around the first contact hole for exposing the drain electrode of the thin film transistor, and

forming a transparent electrode for connecting to the drain electrode of the thin film transistor by way of the second contact hole on the second protective film.

2. The method as claimed in claim 1, wherein a width of the second contact hole is thinner than that of the first contact hole.

3. A method of fabricating an X-ray detecting thin film transistor, in a method of fabricating an X-ray detecting storage capacitor, comprising the steps of:

forming a storage capacitor having a storage electrode on a substrate,

entirely forming a first protective film for covering the storage electrode,

forming a first contact hole for exposing the storage electrode of the storage capacitor on the first protective film,

entirely forming a second contact hole for covering the first protective film on the first protective film,

forming a second contact hole provided on the second protective film centering around the first contact hole for exposing the storage electrode of the storage capacitor, and

forming a transparent electrode for connecting to the storage electrode of the storage capacitor by way of the second contact hole on the second protective film.

4. The method as claimed in claim 3, wherein a width of the second contact hole is thinner than that of the first contact hole.

FIG.1

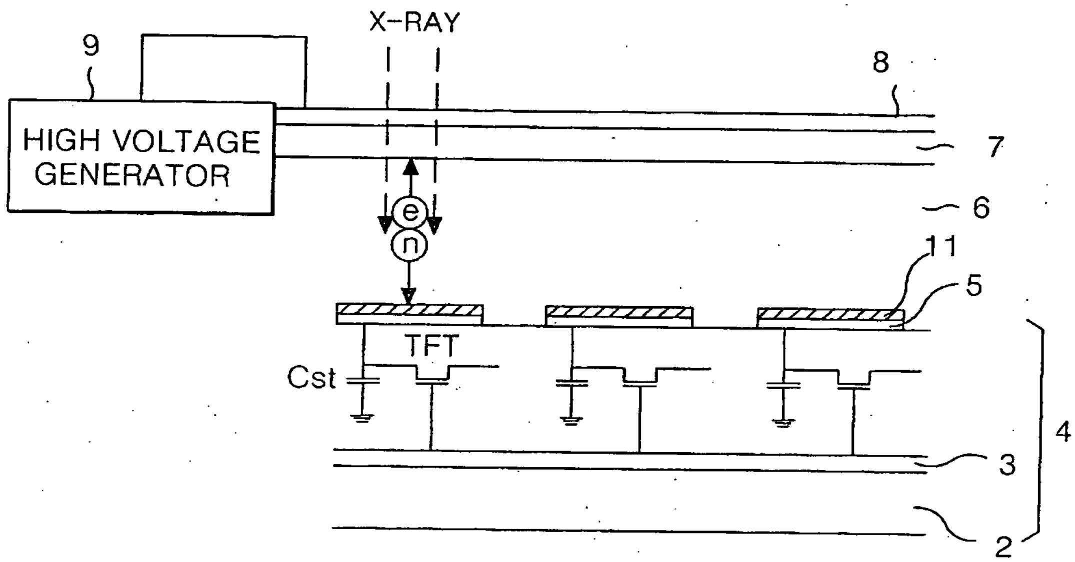

FIG.2A

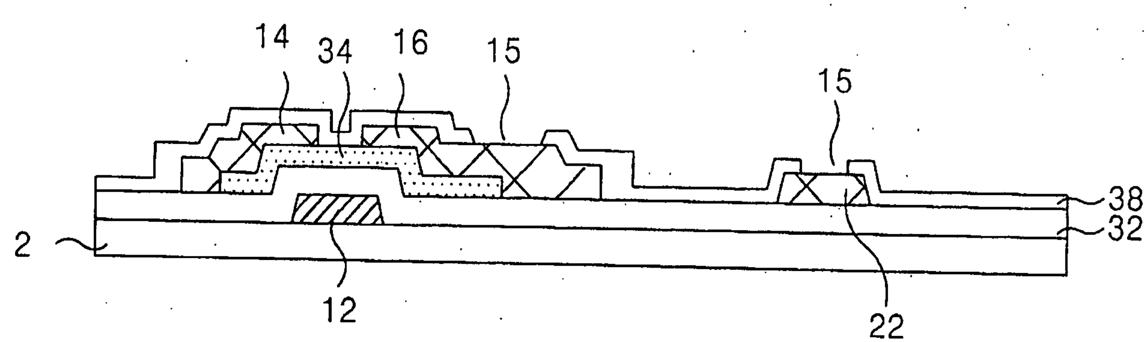

FIG.2B

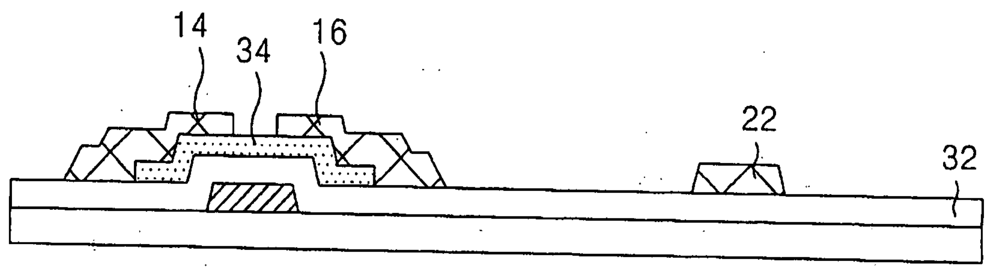

FIG.2C

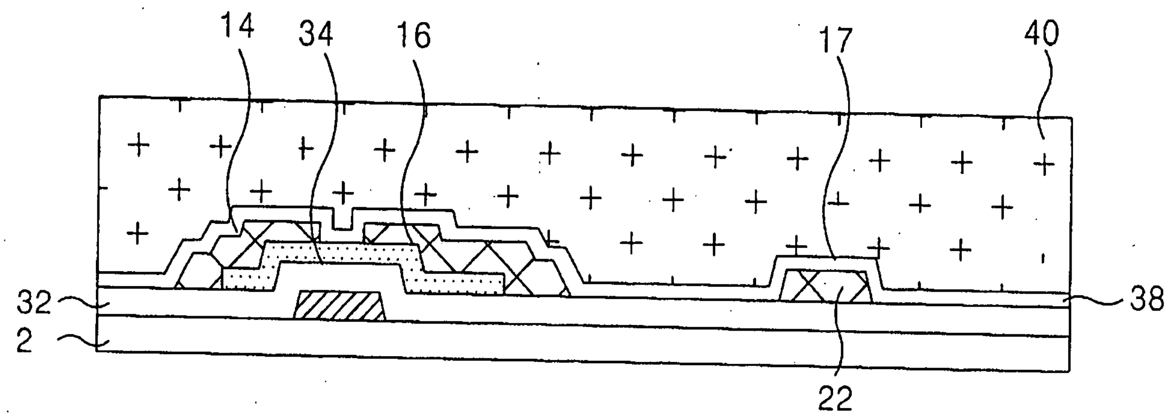

FIG.2D

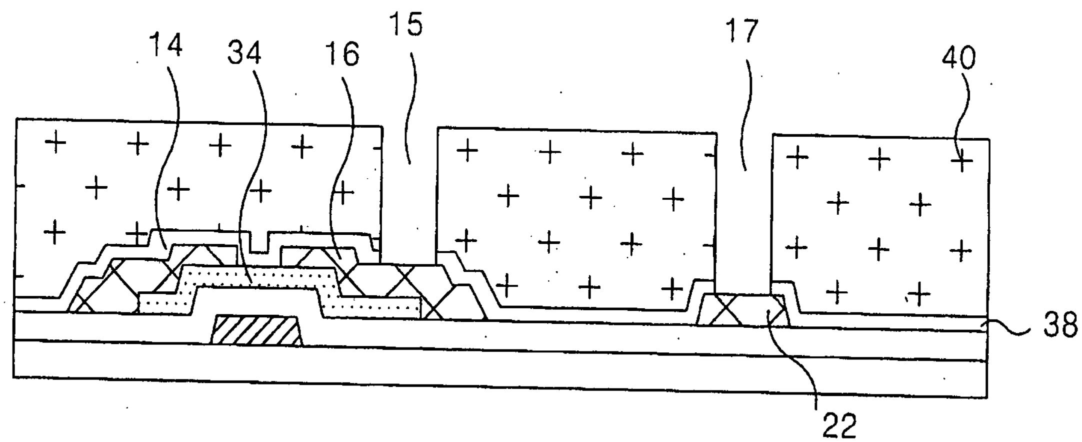

FIG.2E

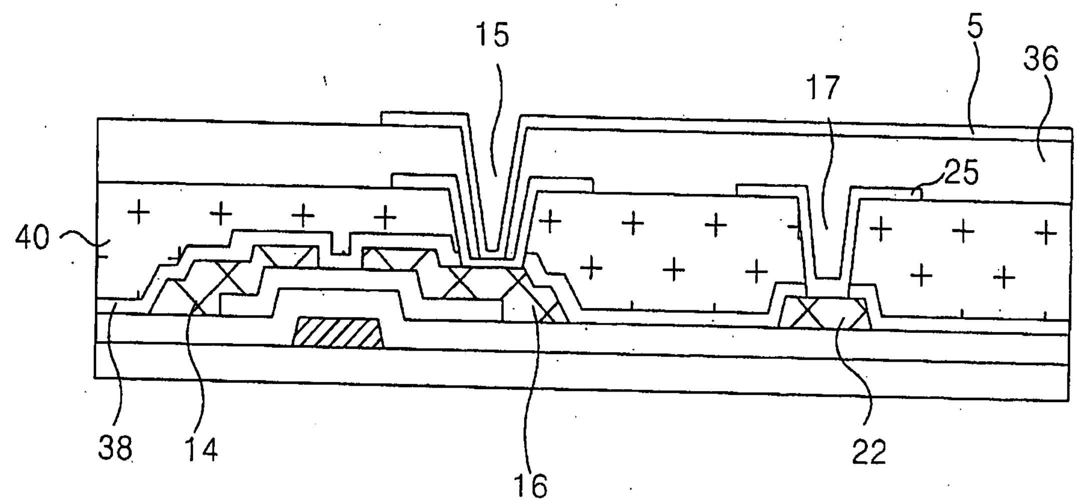

FIG.3

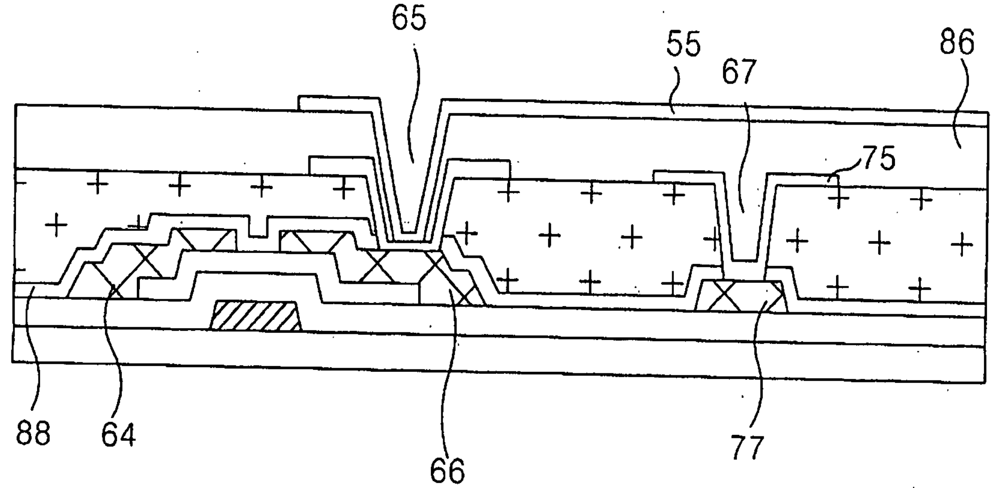

FIG.4A

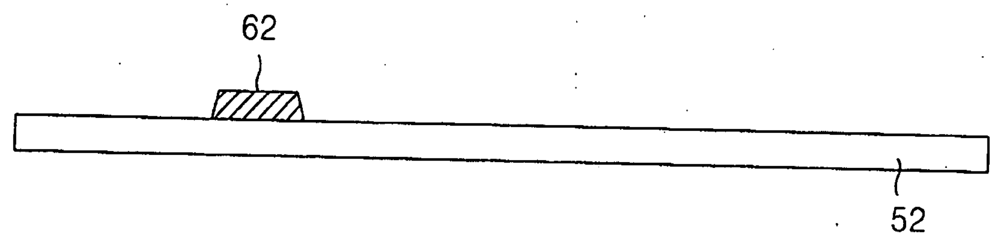

FIG.4B

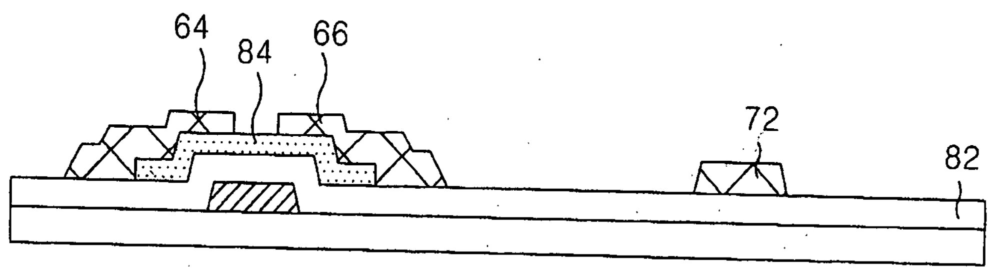

FIG.4C

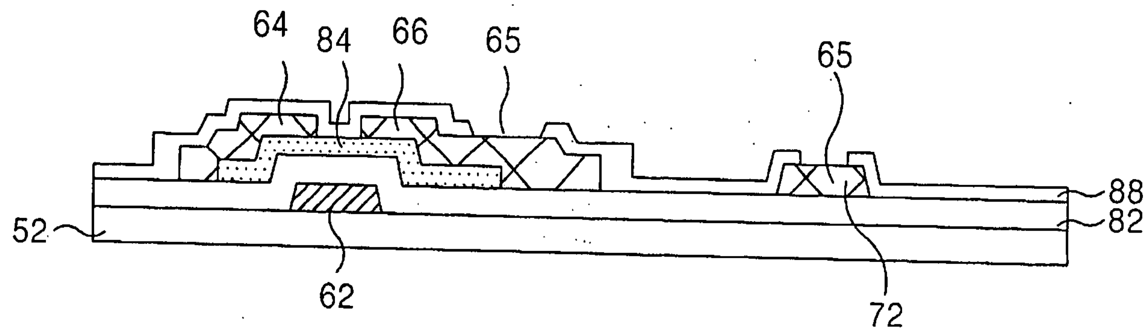

FIG.4D

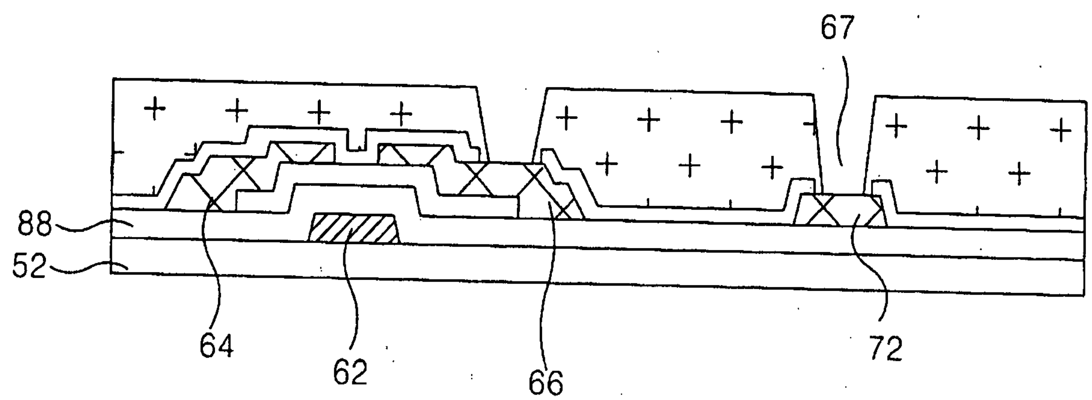

FIG.4E